AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): An audio data encoding apparatus comprising:

a time-to-frequency converting unit that receives a time domain audio signal and converts the time domain audio signal to a frequency domain audio signal;

a spectral processor that receives the frequency domain audio signal and performs spectral processing on the frequency domain audio signal according to an audio encoding format;

a masking threshold calculator that receives the frequency domain audio signal, calculates an energy level for each frequency band of the frequency domain audio signal, approximates an energy distribution curve to a distribution pattern of noise threshold levels calculated by a psychoacoustic model, the energy distribution curve connecting the calculated energy levels, and calculates a scalefactor band gain for each frequency band; and

a quantization noise curve adjuster that adjusts a common gain to meet a target bit rate and matches a quantization noise curve to the approximated energy distribution curve while fixing the scalefactor band gain for each frequency band,

wherein the masking threshold calculator comprises:

an energy distribution curve calculator that performs Modified Discrete Cosine Transform (MDCT) on the frequency domain audio signal to calculate the energy level for each frequency band;

a quantization noise curve pattern estimator that adjusts quantization noise distribution by relatively adjusting a gain for each frequency band based on the calculated energy distribution curve in order to approximate the energy distribution curve to the distribution pattern of noise threshold levels; and

a bit adjustment initial value setter that determines the scalefactor band gain in such a way as to use more bits than the target bit rate.

2. (original): The apparatus of claim 1, wherein the time-to-frequency converting unit performs Modified Discrete Cosine Transform (MDCT) on the input time domain signal.

3. (original): The apparatus of claim 1, wherein the spectral processor performs Temporal Noise Shaping (TNS), Long Term Prediction (LTP), or Perceptual Noise Substitution (PNS) according to an audio encoding format.

4. (canceled).

5. (original): The apparatus of claim 1, wherein the quantization noise curve adjuster compares the number of bits available for a given bit rate with the number of bits used, and if the

number of bits used is smaller than the number of bits available, performs encoding using the number of bits available, or, if the number of bits used is not smaller than the number of bits available, repeats matching of the quantization noise curve.

6. (currently amended): A quantization noise distribution adjusting unit comprising:

a masking threshold calculator that receives a frequency domain audio signal, calculates an energy level for each frequency band of the frequency domain audio signal, approximates an energy distribution curve to a distribution pattern of noise threshold levels calculated by a psychoacoustic model, the energy distribution curve connecting the calculated energy levels, and calculates a scalefactor band gain for each frequency band; and

a quantization noise curve adjuster that adjusts a common gain to meet a target bit rate and matches a quantization noise curve to the approximated energy distribution curve while fixing the scalefactor band gain for each frequency band,

wherein the masking threshold calculator comprises:

an energy distribution curve calculator that performs Modified Discrete Cosine Transform (MDCT) on the frequency domain audio signal to calculate the energy level for each frequency band;

a quantization noise curve pattern estimator that adjusts quantization noise distribution by relatively adjusting a gain for each frequency band based on the calculated energy distribution curve in order to approximate the energy distribution curve to the distribution pattern of noise threshold levels; and

a bit adjustment initial value setter that determines the scalefactor band gain in such a way as to use more bits than the target bit rate.

7. (currently amended): An audio data encoding method comprising:

(a) receiving a time domain audio signal and converting the time domain audio signal to a frequency domain signal;

(b) performing spectral processing on the frequency domain signal according to an audio encoding format;

(c) receiving the frequency domain signal, calculating an energy level for each frequency band of the frequency domain signal, approximating an energy distribution curve to a distribution pattern of noise threshold levels calculated by a psychoacoustic model, the energy distribution curve connecting the calculated energy levels, and calculating a scalefactor band gain for each frequency band; and

(d) adjusting a common gain to meet a target bit rate and matching a quantization noise curve to the approximated energy distribution curve while fixing the scalefactor band gain for each frequency band

wherein (c) comprises:

(c1) calculating the energy level for each frequency band with the frequency domain signal;

(c2) approximating the energy distribution curve to the distribution pattern of noise threshold levels by approximating the energy level for each frequency band and estimating the pattern of a quantization noise distribution curve using a distribution pattern of the approximated energy levels; and

(c3) determining an initial value for bit adjustment in order to match the quantization noise distribution curve to the energy level for each frequency band according to a target bit rate and calculating a scalefactor band gain for each frequency band,

wherein in (c2), if a signal in one of adjacent frequency bands has an energy level greater than that of a signal in a particular frequency band, the energy level of the signal in the particular band is increased by a predetermined ratio with respect to a difference with the greater energy level in the adjacent frequency band.

8-9. (canceled).

10. (currently amended): The method of ~~claim 8~~claim 7, wherein in (c3), a signal having a largest energy level is found among signals in all frequency bands, a gain for each frequency band is determined according to a difference between the largest energy level and an energy level of a signal in each frequency band, and the quantization noise distribution for each frequency band is approximated in the form of a noise threshold.

11. (currently amended): A quantization noise distribution adjustment method comprising:

(a) receiving a frequency domain audio signal, calculating an energy level for each frequency band of the frequency domain audio signal, approximating an energy distribution curve to a distribution pattern of noise threshold levels calculated by a psychoacoustic model, the energy distribution curve connecting the calculated energy levels, and calculating a scalefactor band gain for each frequency band; and

(b) adjusting a common gain to meet a target bit rate and matching a quantization noise curve to the approximated energy distribution curve while fixing the scalefactor band gain for each frequency band,

wherein (a) comprises:

(a1) calculating the energy level for each frequency band with the frequency domain signal;

(a2) approximating the energy distribution curve to the distribution pattern of noise threshold levels by approximating the energy level for each frequency band and estimating the pattern of a quantization noise distribution curve using a distribution pattern of the approximated energy levels; and

(a3) determining an initial value for bit adjustment in order to match the quantization noise distribution curve to the energy level for each frequency band according to a target bit rate and calculating a scalefactor band gain for each frequency band,

wherein in (a2), if a signal in one of adjacent frequency bands has an energy level greater than that of a signal in a particular frequency band, the energy level of the signal in the particular band is increased by a predetermined ratio with respect to a difference with the greater energy level in the adjacent frequency band.

12. (currently amended): A computer-readable recording medium that records a program for executing an audio data encoding method on a computer, the method comprising:

(a) receiving a time domain audio signal and converting the time domain audio signal to a frequency domain signal;

(b) performing spectral processing on the frequency domain signal according to an audio encoding format;

(c) receiving the frequency domain signal, calculating an energy level for each frequency band of the frequency domain signal, approximating an energy distribution curve to a distribution pattern of noise threshold levels calculated by a psychoacoustic model, the energy distribution curve connecting the calculated energy levels, and calculating a scalefactor band gain for each frequency band; and

(d) adjusting a common gain to meet a target bit rate and matching a quantization noise curve to the approximated energy distribution curve while fixing the scalefactor band gain for each frequency band,

wherein (c) comprises:

(c1) calculating the energy level for each frequency band with the frequency domain signal;

(c2) approximating the energy distribution curve to the distribution pattern of noise threshold levels by approximating the energy level for each frequency band and estimating the pattern of a quantization noise distribution curve using a distribution pattern of the approximated energy levels; and

(c3) determining an initial value for bit adjustment in order to match the quantization noise distribution curve to the energy level for each frequency band according to a target bit rate and calculating a scalefactor band gain for each frequency band,

wherein in (c2), if a signal in one of adjacent frequency bands has an energy level greater than that of a signal in a particular frequency band, the energy level of the signal in the particular band is increased by a predetermined ratio with respect to a difference with the greater energy level in the adjacent frequency band.

13. (currently amended): A computer-readable recording medium that records a program for executing a quantization noise distribution adjustment method on a computer, the method comprising:

(a) receiving a frequency domain audio signal, calculating an energy level for each frequency band of the frequency domain audio signal, approximating an energy distribution curve to a distribution pattern of noise threshold levels calculated by a psychoacoustic model, the

energy distribution curve connecting the calculated energy levels, and calculating a scalefactor band gain for each frequency band; and

(b) adjusting a common gain to meet a target bit rate and matching a quantization noise curve to the approximated energy distribution curve while fixing the scalefactor band gain for each frequency band,

wherein (a) comprises:

(a1) calculating the energy level for each frequency band with the frequency domain signal;

(a2) approximating the energy distribution curve to the distribution pattern of noise threshold levels by approximating the energy level for each frequency band and estimating the pattern of a quantization noise distribution curve using a distribution pattern of the approximated energy levels; and

(a3) determining an initial value for bit adjustment in order to match the quantization noise distribution curve to the energy level for each frequency band according to a target bit rate and calculating a scalefactor band gain for each frequency band,

wherein in (a2), if a signal in one of adjacent frequency bands has an energy level greater than that of a signal in a particular frequency band, the energy level of the signal in the particular band is increased by a predetermined ratio with respect to a difference with the greater energy level in the adjacent frequency band.

14. (new): The apparatus of claim 1, wherein the quantization noise curve pattern estimator approximates the energy distribution curve to the distribution pattern of noise threshold levels without using the distribution of noise threshold levels calculated by the psychoacoustic model.

15. (new): The apparatus of claim 6, wherein the quantization noise curve pattern estimator approximates the energy distribution curve to the distribution pattern of noise threshold levels without using the distribution of noise threshold levels calculated by the psychoacoustic model.

16. (new): The apparatus of claim 7, wherein the approximating of the energy distribution curve to the distribution pattern of noise threshold levels is performed without using the distribution of noise threshold levels calculated by the psychoacoustic model.

17. (new): The apparatus of claim 11, wherein the approximating of the energy distribution curve to the distribution pattern of noise threshold levels is performed without using the distribution of noise threshold levels calculated by the psychoacoustic model.

18. (new): The apparatus of claim 12, wherein the approximating of the energy distribution curve to the distribution pattern of noise threshold levels is performed without using the distribution of noise threshold levels calculated by the psychoacoustic model.

19. (new): The apparatus of claim 13, wherein the approximating of the energy distribution curve to the distribution pattern of noise threshold levels is performed without using the distribution of noise threshold levels calculated by the psychoacoustic model.